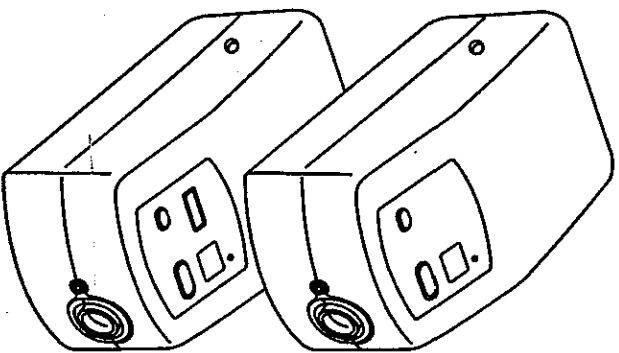


REMstar[®] LX

CPAP System

REMstar[®] Plus LX

CPAP System



Service Manual



REMstar LX and REMstar Plus LX CPAP Systems are the subject of U.S. patent #5239995 and other pending U.S. and foreign patents. Great Performers, REMstar LX and REMstar Plus LX are trademarks of Respironics, Inc.

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REMstar LX and REMstar Plus LX CPAP Systems Service Manual



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Limited Warranty

Respironics warrants that the REMstar LX and REMstar Plus LX CPAP Systems shall be free from defects of workmanship and materials and will perform in accordance with the product specifications for a period of one year from the date of sale by Respironics. If the product fails to perform in accordance with the product specifications, Respironics will repair or replace—at its option—the defective material or part. Respironics will pay customary freight charges from Respironics to the dealer location only. This warranty does not cover damage caused by accident, misuse, abuse, alteration, and other defects not related to materials or workmanship.

Respironics disclaims all liability for economic loss, loss of profits, overhead, or consequential damages which may be claimed to arise from any sale or use of this product. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty is given in lieu of all other express warranties. In addition, any implied warranty, including any warranty of merchantability or fitness for the particular purpose, is limited to one year. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

To exercise your rights under this warranty, contact your local authorized Respironics dealer or contact Respironics at:


RESPIRONICS INC.®
1001 Murry Ridge Lane
Murrysville, Pennsylvania
15668-8550 USA

RESPIRONICS®
Deutschland
Gewerbestrasse 17
D-82211 Herrsching Germany



Visit Respironics Home Page on the World Wide Web at:

www.respironics.com

REMstar LX and REMstar Plus LX CPAP Systems Service Manual

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Overview: REMstar LX and REMstar Plus LX CPAP Systems Service Manual

Warranty	Details the Respironics warranty.
Table of Contents	Lists the chapters included in this manual.
Chapter 1: Introduction	Introduces the REMstar LX and REMstar Plus LX CPAP Systems.
Chapter 2: Warnings, Cautions, and Notes	Lists the Warnings, Cautions, and Notes.
Chapter 3: Specifications, Features, Description and Theory of Operation	Describes the theory of operation for the units, including basic operations of the subsystems.
Chapter 4: System Setup Procedures	Details system setup, including instructions on required, alternate, and optional patient accessories.
Chapter 5: Routine Maintenance	Provides cleaning and routine maintenance instructions.
Chapter 6: Troubleshooting and Diagnostics	Provides a troubleshooting flow chart and a troubleshooting table.
Chapter 7: Repair & Replacement	Describes detailed procedures of removing and installing all major components within the units, including graphics and illustrations for visual identification.
Chapter 8: Testing	Includes the System Final Test, Run-in Test, Post Testing Pressure Setup, and Data Sheet.
Appendix A: Tools and Equipment	Details the necessary tools and test equipment required for servicing.



RESPIRONICS

Overview

Overview (Continued)

Appendix B: Schematics

NOTE: These are proprietary and are to be used for reference only.

Index

Provides Printed Circuit Assembly (PCA) schematics.

Item location guide.

1001417

REMstar LX and REMstar Plus LX CPAP Systems Service Manual

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Chapter 1: Introduction

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Chapter 1: Introduction

1.1 REMstar LX and REMstar Plus LX CPAP Systems Overview

The REMstar LX and REMstar Plus LX CPAP Systems (REMstar LX and REMstar Plus LX), shown in Figure 1-1, are microprocessor-controlled devices that deliver Continuous Positive Airway Pressure (CPAP) therapy in one mode for the treatment of adult Obstructive Sleep Apnea (OSA) only. The CPAP mode provides a constant level of positive pressure throughout the breathing cycle to pneumatically splint the airway open.

The units incorporate a key pad with two User buttons, a Light-Emitting Diode (LED) signal light, a time meter (REMstar Plus LX only), and a 2-digit LED display. The units may be operated using either AC (115 – 230 VAC) or DC (12 VDC) power.

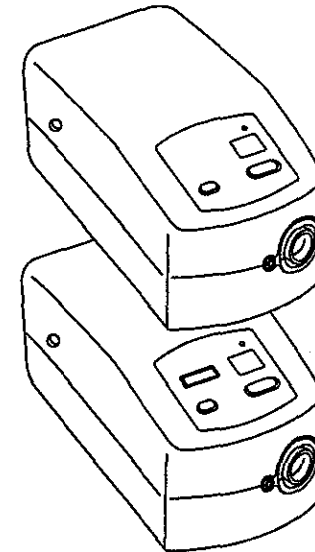


Figure 1-1
REMstar LX and REMstar Plus LX CPAP Systems



1.2 Service Notice

This service manual was prepared by Respironics primarily for use by technicians to service the REMstar LX and REMstar Plus LX Systems. The individuals using this manual to service the REMstar LX and REMstar Plus LX Systems should have prior training or experience servicing ventilatory devices.

1.3 Technical Support Statement

Respironics is committed to customer satisfaction and may be contacted with any questions or for technical support. For technical assistance or replacement part ordering information contact your nearest Respironics Customer Satisfaction Center (CSC).

U.S. and Canada

Phone: 1-800-669-9234
Fax: Available from your nearest CSC

International

Phone: 1-412-731-2100
Fax: 1-412-473-5012

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Chapter 2: Warnings, Cautions, and Notes

WARNING: Indicates the possibility of injury to the patient, operator, or technician.

CAUTION: Indicates the possibility of damage to the devices.

NOTE: Places emphasis on an operating characteristic.

2.1 WARNINGS

2.1.1 Safety

- These devices are intended for adult use only.
- These devices are not intended for life support or life sustaining applications.
- The instructions in this manual are not intended to supersede established medical protocols.

2.1.2 Operational

- This warning applies to most Continuous Positive Airway Pressure (CPAP) devices. At low CPAP pressures, the air flow through the exhalation port may not be enough to clear all of the exhaled gas (CO₂) from the mask. You may breathe in some of the air that you have exhaled.
- Under certain conditions, the temperature of the air flow from these devices can be as much as 18°F (10°C) higher than the air temperature in the room. Caution should be exercised if the room temperature is warmer than 90°F (32°C).
- If oxygen is used with these devices, the oxygen flow must be turned off when the devices are turned off. If the air flow is turned off and the oxygen flow is left on, oxygen may accumulate in the REMstar LX and REMstar Plus LX CPAP Systems enclosure and may create a risk of fire. This warning applies to most types of CPAP devices.
- When supplemental oxygen is used at a fixed flow rate, inhaled oxygen concentrations will vary depending on pressure settings, patient breathing patterns, mask selection, and leak rate.
- Oxygen supports combustion. Do not use oxygen in the presence of open flames, cigarette smoke, electrical spark, or other sources of ignition.



Warnings (Continued)

- These devices are not suitable for use in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide.
- In situations where risk of contamination between the user and the device is high (e.g.: sleep lab devices; rental devices; users with respiratory infections), a low-resistance, main flow bacteria filter should be placed in-line between these devices and the circuit.
- Most CPAP devices have the potential to induce rebreathing of exhaled air. To reduce this potential, use only Respironics circuit accessories, do not wear the mask and headgear for more than a few minutes while the units are not operating, and do not block or try to seal the vent holes in the exhalation port.

2.1.3 Service

- Electronic components used in these devices are subject to damage from static electricity. Repairs made to these devices must be performed only in an antistatic, Electro-Static Discharge (ESD)-protected environment.
- To assure the safety of the service technician and the specified performance of the devices, Respironics recommends that only technicians having prior training or experience servicing ventilatory devices perform any repairs or adjustments to the REMstar LX and REMstar Plus LX.

- High voltages are present inside these devices. To avoid electrical shock, disconnect the electrical supply before attempting any repairs on the devices.

2.1.4 Cleaning

- To avoid electrical shock, disconnect the electrical supply before cleaning the units. DO NOT immerse these devices into any fluids.



2.2 CAUTIONS

- Federal law (U.S.) restricts these devices to sale by, or on the order of, a physician.
- Care should be taken to avoid exposure of the REMstar LX and REMstar Plus LX to temperatures at or near the extremes of those specified in Chapter 3. If exposure to such temperatures has occurred, the devices should be allowed to return to room temperature before being turned on.
- Always use both a pollen filter (RI P/N 622018) and an ultra-fine filter (RI P/N 622017) when the REMstar LX and REMstar Plus LX are in use.
- Never place liquids on or near the REMstar LX and REMstar Plus LX.
- Discontinue using these devices if any of the parts are damaged. Replace any damaged parts before continuing use.
- The information in this manual is provided for service personnel reference and is not intended for system setup or use. System setup should be performed by appropriate personnel using Home Care Dealer Instructions.

2.3 NOTES

- Refer to the REMstar LX and REMstar Plus LX User's Manual for product use additional warnings, cautions, and notes.

Additional WARNINGS, CAUTIONS, and NOTES are located throughout this manual.



Chapter 3: Specifications, Features, Description, and Theory of Operation

3.2 Specifications

ENVIRONMENTAL:

Operating Temperature	41 – 104°F (5 – 40°C)
Storage Temperature	-4 – 140°F (-20 – 60°C)
Humidity	15 – 95% non-condensing
Outlet Temperature Rise	Shall not exceed 122°F (50°C) when operating at a maximum ambient temperature of 104°F (40°C).

NOTE: The outlet temperature rise can be as much as 18°F (10°C) higher than room temperature measured at the end of a 6 ft. (1.83 m) tube.

Atmospheric Pressure	76.7 – 102 kPascals (Storage: 50 – 102 kPascals)
Elevation	0 – 5,000 ft. and greater with three selected ranges available.
Noise Level	No specification is given because various test instruments, test procedures, and unit operating conditions produce varying results. Verify the pressure setting via a manometer for elevation settings over 5,000 ft.

FUSES:

Fuses	0.8 amp or 800 ma time delay (100 – 120 VAC); 0.315 or 315 ma time delay (230 – 240 VAC)
Physical Fuse Size	5 mm × 20 mm

PHYSICAL:

Electrical Safety	IEC 601-1, general safety requirement for medical devices
Dimensions	10.00" (L) × 5.50" (W) × 4.75" (H) (25 × 14 × 12 cm)
Weight	3.5 lbs (1.6 kg)

ELECTRICAL:

AC Input Voltage	100 – 120 VAC; 230 – 240 VAC; 50 – 60 Hz
DC Input Voltage	11 – 17 VDC
AC Current Consumption	T 800 ma at 115 VAC T 315 ma at 230 VAC
DC Current Consumption	3.0 A maximum, time delay, type MDL
Power Consumption	80 VA maximum



Chapter 3: Specifications, Features, Description, and Theory of Operation

Specifications (Continued)

Class Class II
Type Type BF

FUNCTIONS:

Modes CPAP

EMC NORMATIVE DOCUMENTS:

This product complies with the requirements found in the following documents:

IEC 601-1-2 Medical electrical equipment,
general requirements for safety,
and electromagnetic compatibility.

IEC 801-2 Electrostatic discharge require-
ments for industrial process
measurement and control equip-
ment.

IEC 801-3 Radiated electromagnetic field
requirements for industrial process
measurement and control equip-
ment.

IEC 801-4 Electrically fast transients for
industrial process
measurement and control equip-
ment.

CISPR 11 Limits and methods of measure-
ment of electromagnetic distur-
bance characteristics of industrial,
scientific, and medical (ISM)
equipment.

ALTITUDE COMPENSATION:

Pressure Range 4.0 – 20.0 cm H₂O

Settings Low
(0 – 2500 ft.; 0 – 762 m)

Mid (Medium)
(2501 – 5000 ft.; 763 – 1524 m)

High
(greater than 5,000 ft.)

RAMP SETTINGS

Ramp Time 5 - 45 minutes
Adjustable in 5 minute increments.

TIME METER (REMSTAR PLUS LX ONLY):

Time Meter (LCD) Total Operation Time



Chapter 3: Specifications, Features, Description, and Theory of Operation

Functional Description (Continued)

The patient circuit is made up of the flexible tubing, outlet swivel with pressure tubing, exhalation port, and nasal mask. The units apply CPAP to the patient's upper airway to keep the airway open during sleep. Air flow generated from the units is directed to the patient via a mask and flexible tubing that connects to the air outlet port of the units.

The Ramp feature lets the user reduce the pressure from the REMstar LX and REMstar Plus LX so that the patient can fall asleep at a lower, more comfortable pressure at any time or as many times as needed during the night.

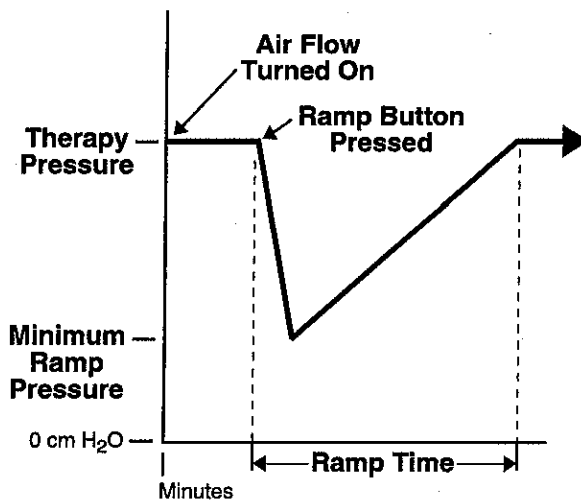


Figure 3-1
Ramp Operation

WARNING: The units are intended to deliver CPAP therapy only. They are not intended for life support or life sustaining applications.

The following sections describe the major components of the REMstar LX and the REMstar Plus LX and their basic theory of operation.

Ramp Settings

The minimum ramp pressure is factory set at 4 cm H₂O and cannot be changed. The ramp time can be set from 0 to 45 minutes (5 minute increments). The first time the ramp button is pressed, the pressure will reduce to 4 cm H₂O and then increase in a linear fashion over the set time period until the pressure setting is reached. After the first activation, each subsequent ramp will be for **one-half** of the set ramp time. The blower must be turned off with the Pressure On/Off button and then back again to reset the ramp to the full time.

- To view the ramp time setting, enter the system set-up by simultaneously holding the ramp and pressure on/off buttons down while plugging the power cord into an electrical outlet. Release the button when the unit turns on.
- The airflow will automatically turn on and the display screen will show the current elevation setting.
- Press and release the on/off button to view the ramp setting.
- To change the ramp time setting, press and release the ramp button until the correct setting is displayed.



3.5 Theory of Operation

3.5.1 Key Pad & Time Meter

The key pad consists of two User buttons (Ramp button, Blower On / Off button), a LED signal light, a time meter (REMstar Plus LX only), and a 2-digit LED display. The Blower On / Off button activates and deactivates the pressure. The range of pressure is 4.0 to 20.0 cm H₂O with AC and DC operation. The Ramp button initiates a ramp cycle which incrementally and automatically increases the pressure. The ramp begins at the minimum ramp pressure setting, and over the specified time period, increases until the therapeutic pressure is reached. Ramp time is dealer adjustable from 0 - 45 minute in 5 minute increments. The LED signal light indicates power and blower On / Off status. The time meter indicates the total number of hours the unit has been in use. Three altitude compensation levels (low, medium, and high) may also be set. The 2-digit LED display indicates the altitude and pressure setting.

3.5.2 Main Printed Circuit Assembly (Main PCA)

The Main PCA is the control center of the units. The Main PCA utilizes two microcontroller chips which read from and write to various I/O devices (key pad, LED, motor control circuitry, etc.). With all of this information, the main microcontroller makes appropriate decisions so that the blower motor is properly controlled to deliver the desired CPAP therapy in a safe and reliable manner.

The main microcontroller and other interface circuitry provide closed loop control of the blower motor's speed. The blower motor is a three-phase brushless DC motor with a permanent magnet rotor and stationary

coils that are connected in the "Y" configuration and serve as its stator coils. The stator coils are electrically switched or commutated by drive circuits with the power FET transistors. Proper timing and sequencing of the stator coil switching is provided by the motor microcontroller which senses the motor's shaft position by monitoring the back-EMF voltage in one of the motor's stator coils.

The main microcontroller also sets the motor speed (and consequently the output pressure) by varying the voltage which is delivered to the motor. It does this by controlling the pulse duty cycle of a switching power supply (boost mode) on the Main PCA.

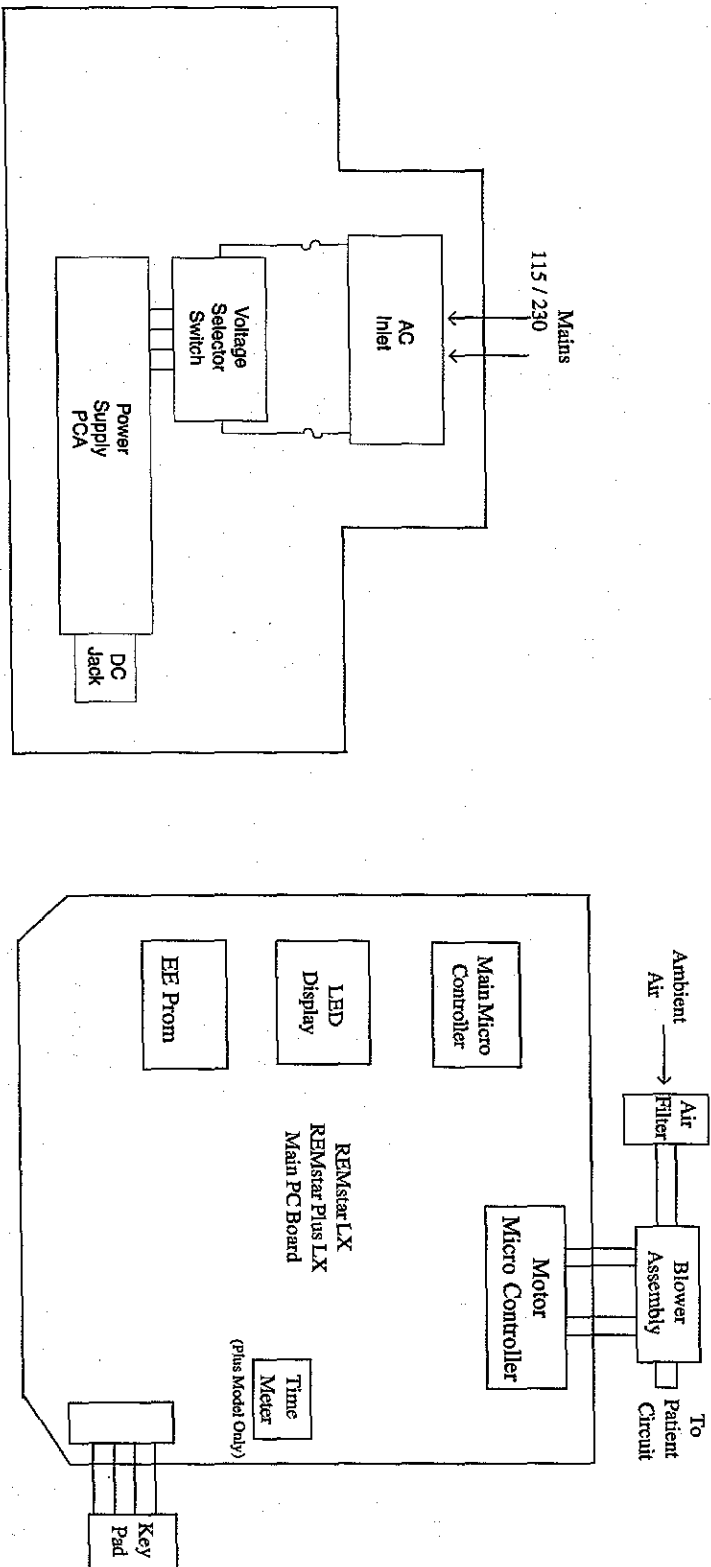
The time meter PCA does not require electrical power from an on-board battery to retain time.

3.5.3 Power Supply Printed Circuit Assembly (Power Supply PCA)

The REMstar LX and REMstar Plus LX is operational over the input voltage ranges of 100 - 120 VAC @ 50 - 60 Hz, 230 - 240 VAC @ 50 - 60 Hz, or 11 - 17 VDC. A patient accessible voltage selector switch is provided for 115 and 230 volt selection.

A DC jack is provided for 11 - 17 VDC operation.

3.6 Block Diagram



REMstar LX REMstar Plus LX Power Supply PCA

REMstar LX REMstar Plus LX Main PCA Board

Chapter 4: System Setup Procedures

4.1 Overview	4-3
4.2 System Setup	4-3
4.3 Required, Alternate, and Optional Circuit Accessories	4-6

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Chapter 4: System Setup Procedures

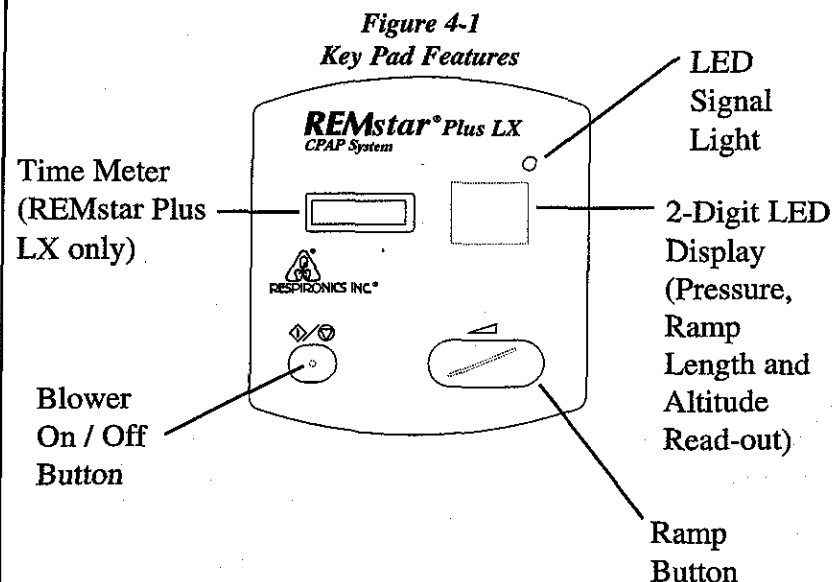
4.1 Overview

This section provides an overview of the system setup including detailed required, alternate, and optional circuit accessories. See Chapter 5 – Routine Maintenance, for filter and filter cap installation instructions

CAUTION: If the REMstar LX and REMstar Plus LX CPAP Systems (REMstar LX and REMstar Plus LX) have been exposed to either very hot or very cold temperatures, allow them to adjust to room temperature (approximately two hours) before beginning setup.

4.2 System Setup (Dealer Mode)

- Step 1** If installed, remove the protective cap from the air outlet. Install the test orifice (RI P/N 622032) onto the unit outlet.
- Step 2** Plug the male end of the AC power cord into an electrical outlet.
- Step 3** Simultaneously, press the two User buttons and plug the female end of the AC power cord into the AC inlet on the back of the unit. Hold the two User buttons down to enter dealer mode.





System Setup (Continued)

NOTE: DO NOT turn the airflow on until a test adapter is connected. (RI P/N 622032)

4.2.1 Self-Diagnostic Test

After the unit is plugged into an electrical outlet, it will perform a Self-Diagnostic Test.

The blower will turn on and the 2-digit LED display will indicate the altitude setting.

4.2.2 Setting the Altitude

The altitude may be set in either Dealer mode or User mode. While holding down the two User buttons or the key pad, plug the AC power cord into the unit. The altitude setting will be displayed on the 2-digit LED. To ensure proper therapy, this setting needs to be accurate for the patient's current location. The altitude displays are:



LOW 0 – 2,500 ft. (0 – 762 m)



MID 2,501 – 5,000 ft. (763 – 1,524 m)



HIGH greater than 5,000 ft.

If the correct setting is displayed, press the left User button. To change the altitude setting, press the right User button until the correct setting is displayed.

NOTE: Altitudes over 5,000 ft. (1,524 m) may affect the accuracy of the pressure. Verify the pressure settings with a manometer.



System Setup (Continued)

4.2.3 Setting the Ramp Time

The minimum ramp pressure is factory set at 4 cm H_2O and cannot be changed. The ramp time can be set from 0 to 45 minutes (5 minute increments). The first time the ramp button is pressed, the pressure will reduce to 4 cm H_2O and then increase in a linear fashion over the set time period until the pressure setting is reached. After the first activation, each subsequent ramp will be for *one-half* of the set ramp time. The blower must be turned off with the Pressure On/Off button and then back again to reset the ramp to the full time.

- a. To view the ramp time setting, enter the system set-up by simultaneously holding the ramp and pressure on/off buttons down while plugging the power cord into an electrical outlet. Release the button when the unit turns on.
- b. The airflow will automatically turn on and the display screen will show the current elevation setting.
- c. Press and release the on/off button to view the ramp setting.
- d. To change the ramp time setting, press and release the ramp button until the correct setting is displayed.

4.2.4 Setting the Pressure

The pressure may set without the use of a manometer. The manometer is only needed if pressure accuracy is suspect. If pressure accuracy needs checked follow steps a - g.

- a. Connect the following:

- 6 ft. Smooth-Bor tubing to the outlet port on the unit.
 - Whisper Swivel II to the 6 ft. Smooth-Bor tubing.
 - Test orifice 60 lpm @ 14.4 cm (RI P / N 622032) to the Whisper Swivel II.
 - Manometer and pressure tubing to test orifice.
 - Occlude test orifice.
- b. Ensure the blower is off. Unplug the AC power cord from the unit. The green LED will go out.
 - c. While holding down the two User buttons on the key pad, plug the AC power cord into the unit. The same displays used for the Minimum Pressure Test (see Section 8.2) should be visible.
 - d. Verify the following:
 - the blower is running in the unit; and the proper altitude setting is indicated on the display.
 - e. Press the left User button twice until the Pressure display appears.
 - f. Press the right User button until "20" appears. Each press of the right User button increments the pressure by 0.5 cm.
 - g. Press the Blower On / Off button and verify the pressure on the manometer is 20.0 cm H_2O (± 2.25 cm H_2O).



4.3 Recommended, Alternate, and Optional Circuit Accessories

This section addresses the recommended, alternate, and optional circuit accessories that can be used with the REMstar LX and REMstar Plus LX. For additional information, refer to the User's Manual or the Home Care Providers Manual or the literature supplied with the accessory.

4.3.1 Required Accessories

To use the REMstar LX and REMstar Plus LX Systems, the following accessories are recommended in order to assemble the circuit.

WARNING: The REMstar LX and REMstar Plus LX Systems should only be used with the recommended patient circuit identified below.

Recommended Patient Circuit

- Respironics Nasal Mask & Whisper Swivel® II Exhalation Port (or Respironics mask w/integrated exhalation port such as the Monarch® Mini Mask)
- Respironics 6 ft. (1.83 m) Flexible Tubing Assembly (reusable or lightweight)
- Respironics Headgear or Softcap™ (not shown)

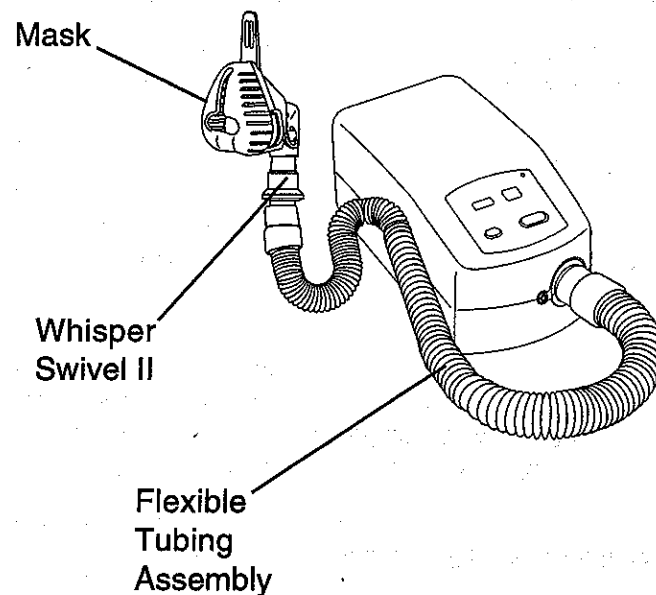


Figure 4-2
Unit with Circuit



Recommended, Alternate, and Optional Circuit Accessories (Continued)

4.3.2 Alternate and Optional Circuit Accessories

The Respironics alternate accessories, listed in Table 4-1, can be used in place of the recommended accessories. The optional accessories can be added to the patient circuit. Refer to Table 4-1 for changes in the pressure / flow characteristics when using these accessories.

Table 4-1, Patient Circuit Accessory Pressure / Flow Characteristics

	Pressure Drop @ 30 lpm (cm H ₂ O)	Pressure Drop @ 60 lpm (cm H ₂ O)
Recommended Patient Circuit		
Nasal Mask (disposable, reusable)	0.03	0.09
GoldSeal™ Nasal Mask (reusable)	0.03	0.09
Monarch® Mini Mask	0.20	0.77
Whisper Swivel® II (reusable)	0.02	0.08
6 ft. (1.83 m) Reusable Flexible Tubing	0.11	0.30
Alternate Accessories		
Spectrum® Disposable Full Face Mask	0.04	0.10
Plateau™ Exhalation Valve (reusable)	0.05	0.20
6 ft. (1.83 m) Disposable Circuit & Exhalation Port	0.20	0.34
Optional Accessories		
Respironics Oasis™ Humidifier	0.14	0.40
24 in. Reusable Tubing (used with humidifier)	0.03	0.10
18 in. Disposable Tubing (used with humidifier)	0.00	0.00
18 in. Reusable Tubing (used with humidifier)	0.00	0.10
King Bacteria Filter (disposable)	0.74	1.65
Comfort Flap® Mask Accessory (reusable)	0.00	0.00



Recommended, Alternate, and Optional Circuit Accessories (Continued)

The following graph provides the exhaust / flow characteristics of the exhalation port accessories that can be used with the REMstar LX and REMstar Plus LX Systems. This information may help assess the CO₂ rebreathing potential of various circuit configurations at different applied pressures.

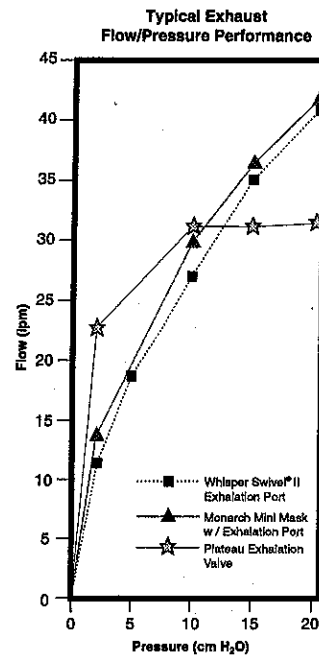


Figure 4-3
Typical Exhaust Flow / Pressure Performance

WARNING: Appropriate diagnostic pressures must be determined when alternate or optional accessories are in place. Respironics reusable circuit accessories are washable, but are for single patient use only. They are not intended to be used on multiple patients.

4.3.3 DC Power Accessories

The Respironics DC Power Cord (RI P/N 1000815) can be used to operate the REMstar LX and REMstar Plus LX Systems in a stationary recreational vehicle, boat, truck, or motor home.

The Respironics DC Battery Adapter Cable (RI P/N 532209), when used with the Respironics DC Power Cord, enables the REMstar LX and REMstar Plus LX Systems to be operated from a 12 VDC free-standing battery.

NOTE: Respironics recommends a 100 amp-hour deep cycle marine battery. A fully charged battery of this size will supply approximately 20 hours of therapy.

The units should not be operated while the vehicle is in motion.

CAUTION: Only use the Respironics DC Power Accessories. Use of any other system may cause damage to the REMstar LX and REMstar Plus LX or your vehicle.

CAUTION: DC Power is not intended to be used as battery back-up. DO NOT connect the DC Power while the units are operating on AC Power. System damage may occur.



Recommended, Alternate, and Optional Circuit Accessories
(Continued)

4.3.4 Adding a Humidifier

When using a humidifier, always disconnect the humidifier tubing from the REMstar LX and REMstar Plus LX Systems when they are turned off. DO NOT use a room humidifier within 6 ft. (1.83 m) of the units. Moisture can build up in the systems and cause damage. Follow the instructions included with the humidifier.

When using a heated humidifier, avoid using a high temperature setting which may cause water to collect in the tubing.

4.3.5 Adding Oxygen to the System

Please note the warnings listed below when using oxygen with the REMstar LX and REMstar Plus LX Systems.

WARNING: When using oxygen with the systems, turn the units on before turning the oxygen on. Turn the oxygen off before turning the units off. This will prevent oxygen accumulation in the room.

WARNING: Oxygen supports combustion. Do not use oxygen in the presence of open flames, cigarette smoke, electrical spark, or other sources of ignition.

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Chapter 5: Routine Maintenance

5.1 Overview	5-3
5.2 Cleaning the System	5-3
5.2 Recording the Total Operating Time (REMstar Plus LX Only)	5-3
5.4 Cleaning / Replacing the Intake Filters	5-4
5.5 REMstar LX and REMstar Plus LX CPAP Systems Preventive Maintenance Schedule	5-5

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Chapter 5: Routine Maintenance

5.1 Overview

This chapter provides guidelines and illustrates the cleaning and maintenance procedures for the REMstar LX and REMstar Plus LX CPAP Systems (REMstar LX and REMstar Plus LX).

Before cleaning or performing any routine maintenance, always switch the Blower On / Off button to the Off position and unplug the power cord from the rear of the unit.

5.2 Cleaning the System

WARNING: To avoid electrical shock, disconnect the electrical supply before attempting to clean the units. **DO NOT** immerse the units in water or allow any liquid to enter the cabinet or the filter intake.

Step 1 Wipe the outside of the unit with a cloth slightly dampened with water and a mild detergent. Let the unit dry before reconnecting the electrical supply.

5.3 Recording the Total Operating Time (REMstar Plus LX Only)

The total operating time is displayed on the REMstar Plus LX time meter. The time meter is located on the left display and is signified by an hourglass icon.



The total operating time is the total number of hours the unit has been in use. This total includes factory testing time.



5.4 Cleaning / Replacing the Intake Filters

The gray pollen filter is a reusable filter that screens out pollens and some household dust. This filter should be cleaned at least once every two weeks under normal usage, or as required, and replaced with a new one every six months. One additional pollen filter is included with the systems. The pollen filter must be in place at all times when the units are operating.

The disposable white ultra-fine filter increases filtration of pollens, dust, some tobacco smoke, and small particles. The ultra-fine filter is included with the systems, but is optional and should be used in addition to the pollen filter. The ultra-fine filter should never be used without the pollen filter. Replace the ultra-fine filter after 30 nights of use or sooner if it appears dirty. DO NOT clean the ultra-fine filter.

CAUTION: Failure to replace a dirty filter may cause the devices to operate at higher than normal temperatures and damage the devices.

5.4.1 Removing, Cleaning, and Replacing the Filters

- Step 1** With the air flow turned off, disconnect the AC or DC power cord from the back of the unit.
- Step 2** Remove the filter cap by gently pressing down on the top of the filter cap, then pulling it away from the back of the unit.
- Step 3** Remove the pollen filter by gently pulling the edges of the filter. Rinse the filter in a steady stream of running water. Squeeze out the water, and repeat. Allow the pollen filter to air dry on a rack for 8 to 12 hours, or in a clothes dryer for 15 to 20 minutes.
- Step 4** If you are using the white ultra-fine filter, remove the ultra-fine filter if it appears dirty and discard. Replace with a new filter. Make sure the filter is lying flat.
- Step 5** Place the pollen filter over the ultra-fine filter, if used. Install the filter(s) into the filter area in the back of the unit.

CAUTION: The pollen filter must be completely dry before use. Never place a wet filter into the device. Respironics recommends that you clean the filter in the morning and alternate using the two pollen filters provided with the systems to ensure enough drying time for the cleaned filter.



Cleaning / Replacing the Intake Filters (Continued)

- Step 6** Install the filter cap. The opening in the filter cap can be installed in either direction.

5.5 REMstar LX and REMstar Plus LX CPAP Systems Preventive Maintenance Schedule

The following Preventive Maintenance Schedule lists the items that must be inspected or tested periodically, or after service is performed. Use the Preventive Maintenance Schedule to record the dates on which the maintenance items are performed.

You may photocopy the Preventive Maintenance Schedule for each unit serviced.



REMstar LX and REMstar Plus LX CPAP Systems Preventive Maintenance Schedule (Continued)

5.5.1 REMstar LX and REMstar Plus LX Preventive Maintenance Schedule (Factory Recommended)

Model No. _____ Serial No. _____ Notification No. _____

Maintenance Item	Verification Reference	Service Interval	Date
Record hours of operation (REMstar Plus LX only)	Time meter	As desired	
Replace pollen filter	Section 5.4.1	Clean every 2 weeks, or as required; Change every 6 months, or as required	
Replace ultra-fine filter (if used)	Section 5.4.1	Replace after 30 nights of use (sooner if it appears dirty)	
Perform Testing Process	Section 8.1	After service is performed	
Cleaning	Section 5.2	As required	

Tested by: (Signature in ink) _____ Date: _____



Chapter 6: Troubleshooting and Diagnostics

6.1 Overview	6-3
6.2 Troubleshooting Flow Chart	6-4
6.3 Troubleshooting Table	6-5

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Chapter 6: Troubleshooting and Diagnostics

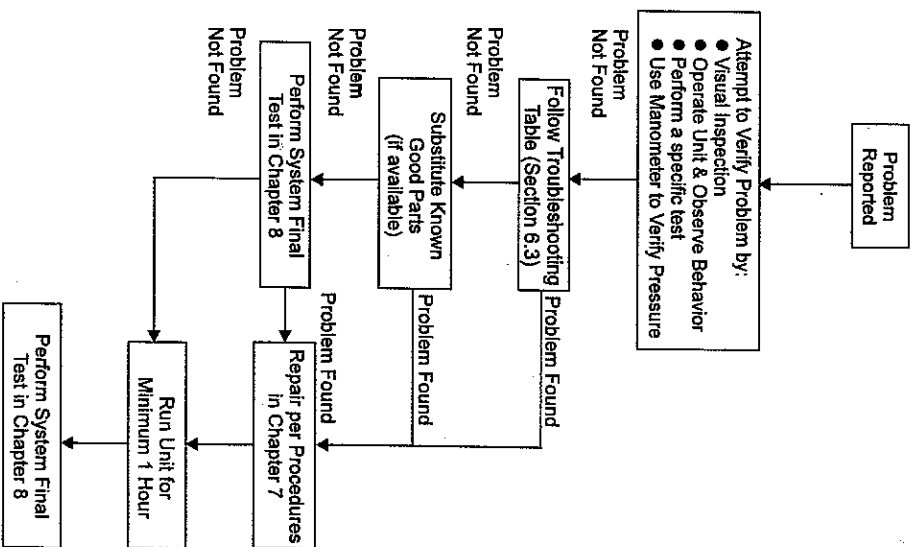
6.1 Overview

WARNING: Electrical Shock Hazard: Disconnect the electrical supply before repairing the units.

CAUTION: Electronic components used in these units are subject to damage by static electricity. Use proper static discharge equipment and grounding precautions when servicing the equipment. Service only at a static-free workstation.

This section contains information necessary to troubleshoot and diagnose problems with the REMstar LX and REMstar Plus LX CPAP Systems. It provides a summary of common system problems as well as a flowchart and table to simplify the troubleshooting process.

6.2 Troubleshooting Flow Chart





6.3 Troubleshooting Table

Symptom	Cause	Verification	Corrective Action
Indicator - LED or other indicator not working.	• Key pad • Interface cable loose • Main PCA	Check connection between the key pad ribbon cable and the Main PCA. Check connection between Main PCA and Power Supply PCA.	Check for secure connection of ribbon cable connector. • Replace Main PCA • Replace Power Supply PCA
Time Meter - Display is blank or contains erroneous information.	• Main PCA	Check connection between Main PCA and Power Supply PCA.	Replace in order until solved: • Main PCA • Power Supply PCA



Chapter 6: Troubleshooting and Diagnostics

Troubleshooting Table (Continued)

Symptom	Cause	Verification	Corrective Action
Intermittent Power Supply Problem - An intermittent on / off condition exists, or indicator lights blink sporadically.	• Power cord, AC inlet, Main PCA, loose connections. • Power Supply PCA.	Inspect power cord for fraying at cable ends. Inspect all connectors on the PCAs. U2 Pin 14 = $+5.00 \text{ VDC} \pm 0.15 \text{ VDC}$	If power supply DC voltage is not within specifications, replace Power Supply PCA. If power cord or connectors are faulty, replace items as required. If +5vdc supply is not within specifications, replace Main PCA.



Troubleshooting Table (Continued)

Symptom	Cause	Verification	Corrective Action
Unit Does Not Operate from the 12 VDC Power Source - Units blow fuses in the DC cord during DC operation.	Faulty DC plug, low DC voltage, fuse in DC cord is blown. Power Supply PCA	Ensure the DC supply is a minimum of 12 VDC. Ensure the DC voltage is stable. Monitor the voltage at the back of the DC connector mounted on the Main PCA. If DC voltage is below 11.5 VDC, replace or recharge DC source. If there is no DC measured at the Power Supply PCA, then check DC adapter cord for continuity.	• If DC cord or source is not at 12 VDC, replace or recharge as required. • If 12 VDC supply is OK, replace Main PCA.
Noise -	Loose screws. Missing or damaged bottom strip on bottom of unit, blower malfunctioning.	Inspect for any loose screws. Turn unit over and inspect the bottom for missing or damaged bottom strip.	• Tighten any loose screws. • If bottom strip is missing, replace bottom strip. • Replace blower.



Chapter 6: Troubleshooting and Diagnostics

Troubleshooting Table (Continued)

Symptom	Cause	Verification	Corrective Action
Odor -	Airborne residue. Tubing smells new. Units smells new.	Visually inspect patient tubing for contamination.	To clear residue build-up from contaminants, replace all subassemblies in the patient air stream (blower, filters, patient circuit). Run unit in a clean environment for a few hours to eliminate new smell. Wash tubing with soap and water.
Outlet Air Temperature - The outlet air temperature is too warm.	Blower, Power Supply PCA. Unit too close to external heat source.	Monitor the outlet air temperature at the end of the six foot tubing. A rise in temperature can be expected. Ensure the unit is not next to any heat source greater than 18°F above room temperature and is not in an enclosed environment.	Replace: • Blower • Power Supply PCA Move unit away from external heat source.



Troubleshooting Table (Continued)

Symptom	Cause	Verification	Corrective Action
Pressure Related Problems - The outlet pressure does not change or properly adjust.	Main PCA or blower malfunction.	Check blower for internal air leaks.	• Replace blower, pressure tubing, or Main PCA as required.
Pressure Offset - Static pressure fluctuates -1.0 cm to +2.0 cm H ₂ O.	The delivered pressure is higher or lower than the set value by more than +2.0 / -1.0 cm H ₂ O.	Perform power up process. Check altitude setting.	• Replace blower. • Replace Main PCA. Set the correct altitude
Unit Blower Turns on When Power Cord is Plugged In.	Unit was unplugged with blower running.	Plug unit in. If blower turns on without pressing the Blower On / Off button, reset the unit.	Turn the blower off and remove the AC power.



Chapter 6: Troubleshooting and Diagnostics

Troubleshooting Table (Continued)

Symptom	Cause	Verification	Corrective Action
Ramp Pressure - The pressure does not ramp correctly.	• Main PCA. • Ramp button not functioning.	Press the Ramp button and verify that the pressure drops below 5.0 cm H ₂ O. Pressure will increase in a linear fashion over time until the pressure setting is reached. Verify one increase in pressure change in ramp operation.	• Replace Main PCA • Replace key pad
Pressure Variation - The pressure varies around the set value, pressure fluctuates greater than 1.0 cm H ₂ O.	• Internal air leak • Filters dirty • Main PCA, blower • Altitude setting • Air path blocked	Check filters. Perform Testing Process (see Chapter 8).	Verify proper altitude setting. Clean / replace filters. Replace blower. Clear air path. If pressure still drifts, then replace Main PCA.

Chapter 7: Repair & Replacement

7.1	Overview	7-3
7.2	REMstar LX and REMstar Plus LX CPAP Systems Repair Kits	7-5
7.3	Warnings and Cautions	7-9
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Chapter 7: Repair & Replacement

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REMstar LX and REMstar Plus LX CPAP Systems Service Manual

7-2



Chapter 7: Repair & Replacement

7.1 Overview

Figure 7-1 lists the names and identifies the locations of the replaceable components in the REMstar LX and REMstar Plus LX CPAP Systems (REMstar LX and REMstar Plus LX). The illustrations provide a quick reference and overview of the units. Within each replacement section, more detailed support information is provided to illustrate the exact component location and replacement procedure(s).

For technical assistance or replacement part ordering information contact your nearest Respironics Customer Satisfaction Center (CSC).

U.S. and Canada

Phone: 1-800-669-9234
Fax: Available from your nearest CSC

International

Phone: 1-412-731-2100
Fax: 1-412-473-5012

Visit Respironics Home Page on the World Wide Web at:

www.respironics.com

7.1.1 REMstar LX and REMstar Plus LX CPAP Systems Exploded View

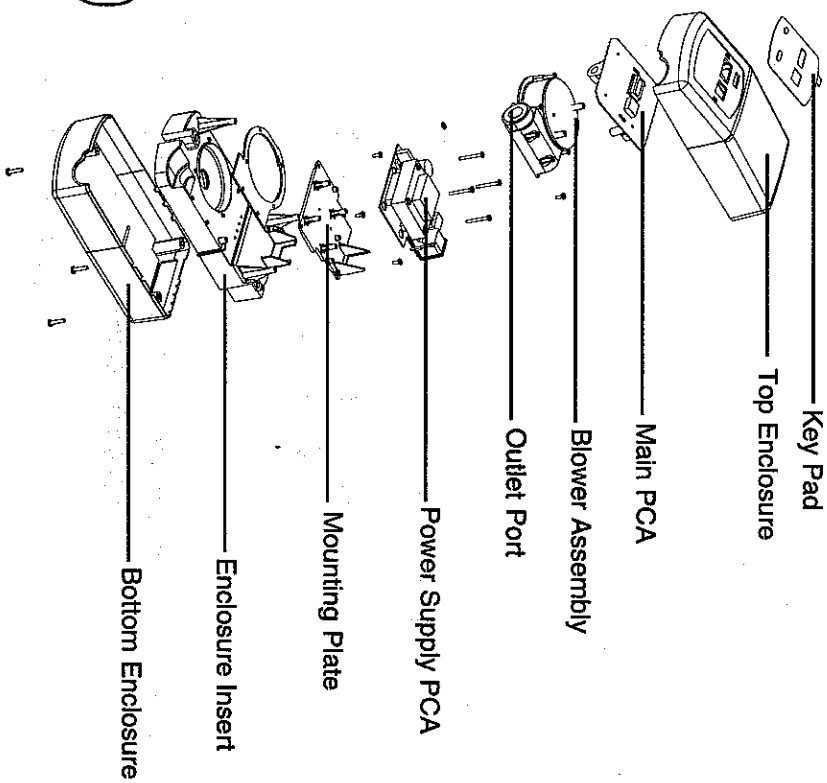


Figure 7-1

REMstar LX and REMstar Plus LX CPAP Systems Exploded View

**7.2 REMstar LX and REMstar Plus LX CPAP Systems Repair Kits**

Replacement Part	Replacement Part No.	Page No.
AC Power Cord (U. S. and Canada)	362524	N.A.
AC Power Cord (International)	See Note ¹	N.A.
Blower Assembly Includes: • Blower assembly (w / foam baffle) • Blower-to-enclosure insert seal • 6-13 × 1" screw (×6) • Ferrite clamp-on (not used for this repair) • Pressure tubing (not used for this repair)	622115	7-29
Bottom Enclosure (REMstar LX and REMstar Plus LX) Includes: • Bottom enclosure (w / foam baffle and bottom strip) • Warning label • 8-11 × 3/4" screw (×3)	1000828 See Note ²	7-14
Bottom Strip	622122	7-12



Chapter 7: Repair & Replacement

REMstar LX and REMstar LX CPAP Systems Repair Kits (Continued)

Replacement Part	Replacement Part No.	Page No.
DC Power Cord (optional)	1001956	N.A.
Enclosure Insert Includes: • Enclosure insert (w / foam baffle) • Blower-to-enclosure insert seal • 6-13 x 1" screw (x6)	622119	7-35
Filter, Disposable, Ultra-fine (x1)	622017	5-3
Filter, Reusable, Pollen (x1)	622018	5-3
Filter Cap (w / foam baffle)	622124	N.A.
Fuse Drawer (REMstar LX and REMstar Plus LX)	622010	N.A.
Fuse Kit, 230-240 VAC (REMstar LX and REMstar Plus LX)	1000709	N.A.
Fuse Kit, 100-120 VAC (REMstar LX and REMstar Plus LX)	1000710	N.A.
Key Pad (REMstar LX)	1000826	7-23



Chapter 7: Repair & Replacement

REMstar LX and REMstar LX CPAP Systems Repair Kits (Continued)

Replacement Part	Replacement Part No.	Page No.
Key Pad (REMstar Plus LX)	1001415	7-23
Main Printed Circuit Assembly (Main PCA) (REMstar LX) Includes: • Main PCA • Tinnerman fastener (×2)	1000830	7-20
Main Printed Circuit Assembly (Main PCA) (REMstar Plus LX) Includes: • Main PCA • Tinnerman fastener (×2)	1001414	7-20
Mounting Plate (REMstar LX and REMstar Plus LX) Includes: • Mounting plate • 6-13 × 3/8" screw (×4)	622252	N.A.
O ₂ Enrichment Port (used for testing)	312010	N.A.
Outlet Port Includes: • Outlet port	1000827	7-26



REMstar LX and REMstar LX CPAP Systems Repair Kits (Continued)

Replacement Part	Replacement Part No.	Page No.
Power Supply Printed Circuit Assembly (Power Supply PCA) Includes: • Power supply PCA • 6-13 × 3/8" screw (×2)	622265	7-32
REMstar LX and REMstar Plus LX Service Manual	1001416	N.A.
Test Orifice (used for testing)	622032	N.A.
Top Enclosure Includes: • Top enclosure • 8-11 × 3/4" screw (×3) • Tinnerman fastener (×2)	1000829	7-16

- Comments:**
- Illustration is shown on page 7-4.
 - All items have a quantity of one unless otherwise specified.
 - Part replacement procedures are detailed within this chapter.
 - Assorted tubing, cables, and hardware are supplied with each Replacement Kit.

Note 1: Contact Respironics International Customer Service for further AC Power Cord information.

Note 2: Contact Respironics Technical Service Department or a Respironics Customer Satisfaction Center for bottom enclosure ordering information.



7.3 Warnings and Cautions

WARNING: To prevent electrical shock, disconnect the electrical supply before attempting to make any repairs to the units.

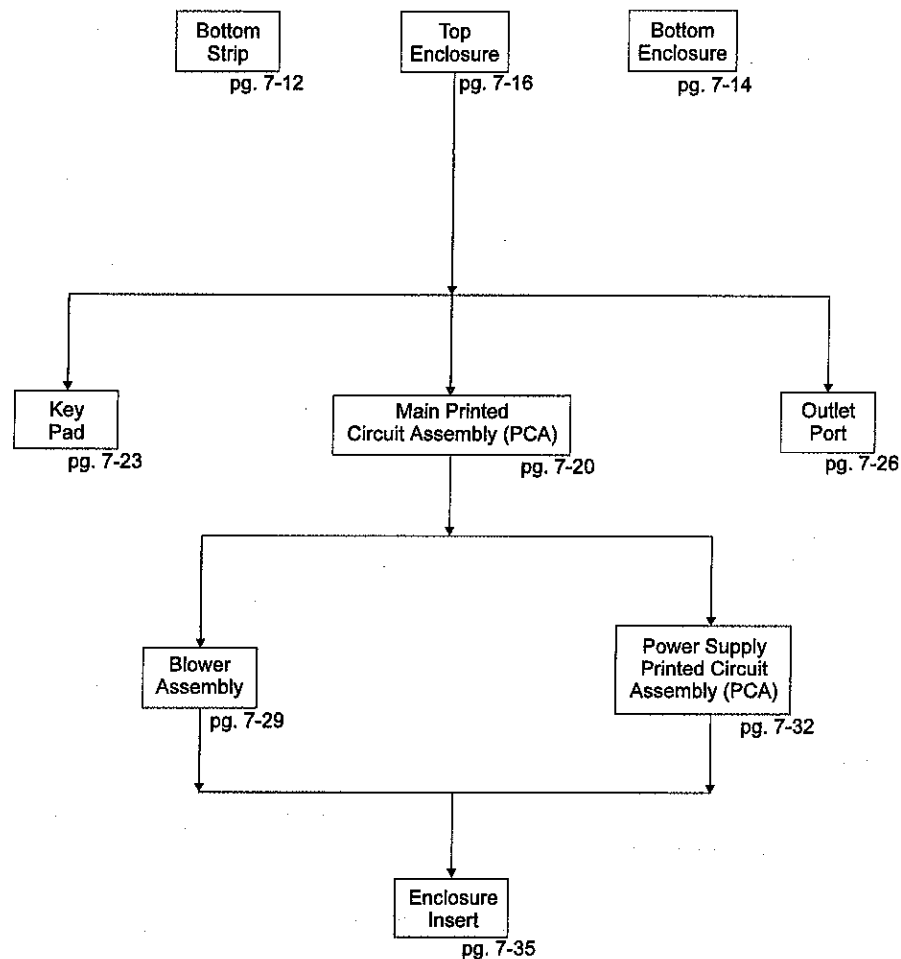
CAUTION: Electronic components used in these units are subject to damage from static electricity. Repairs made to the below listed sub-assemblies must be performed only in an antistatic, Electro-Static Discharge (ESD)-protected environment.

7.4 Replacement Instructions

See Figures 7-2 and 7-3 before removing or installing any component. These figures will detail the order in which each item must be removed or installed and should be used as a guideline for quick reference.



Replacement Instructions (Continued)



Removal Flow Chart

Figure 7-2
Removal Flow Chart

Chart Usage: Determine which item is to be replaced then follow the line of flow back to the "Top Enclosure" and begin the removal process. Detailed procedures begin on the referenced page numbers.